HA12240FP

Bus Interface Driver/Receiver IC

REJ03F0095-0100Z
Rev.1.0
Dec.01.2003

Description

The HA12240FP is developed to be used as a bus interface driver/receiver IC in automotive audio equipment controllers. It implements a two-wire serial bus.

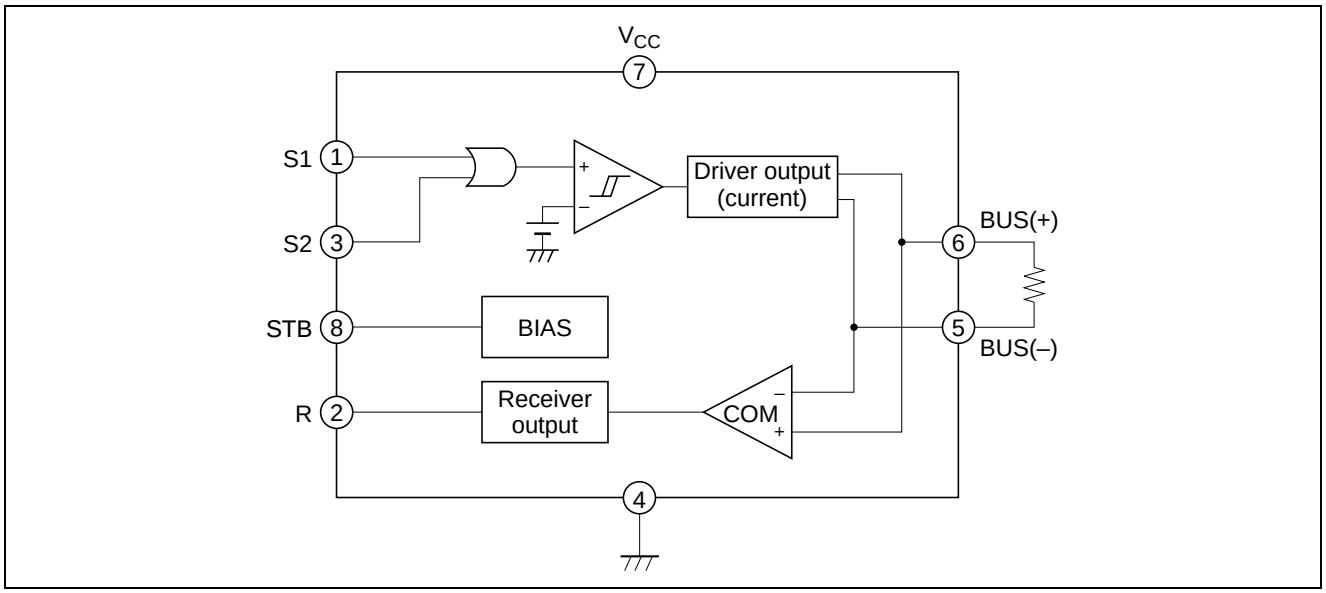
Functions

- Two-input OR circuit
- Input comparator circuit (3.3 V and 5.0 V available)
- Current output driver circuit
- Receiver input comparator circuit
- Receiver output circuit (Open-collector output)
- Standby circuit

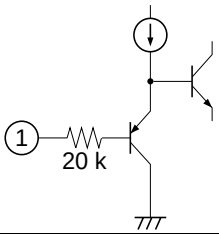
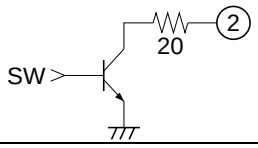
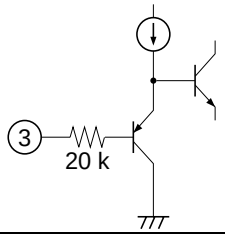
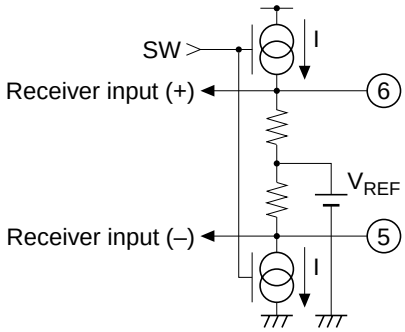
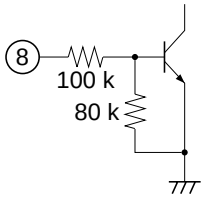
Features

- Supports two data inputs (Pins 1 and 3 are the input pins)
- Comparators with hysteresis characteristics are adopted for the inputs (3.3 V and 5.0 V available)
- Current drive output drivers adopted (Output current: 3.8 mA typical)
- Comparators with hysteresis characteristics are adopted for the receivers
- Wide receiver common-mode input operating range (Common-mode input operating range: 0 to 5 V typical)
- The driver output /the receiver input (pins 5 and 6) can withstand high voltages (Maximum ratings of 18 V)
- Standby functions (standby mode when pin 8 becomes low level)
- Operating power-supply voltage range of 5 V ± 0.5 V

Block Diagram



Pin Functions

Pin No.	Symbol	Function	Equivalent Circuit
1	S1	Data input pin 1	
2	R	Receiver output pin	
3	S2	Data input pin 2	
4	GND	GND pin	
5	BUS(–)	Bus output (–), Receiver input (–) pin	
6	BUS(+)	Bus output (+), Receiver input (+) pin	
7	V_{CC}	Power supply pin	
8	STB	Standby input pin (Lo: ON, Hi: OFF)	

Absolute Maximum Ratings

(Ta = 25°C)

Item	Symbol	Ratings	Unit	Note
Power-supply voltage	V_{CC}	7	V	
Input voltage	V_{IN}	GND–0.3 to V_{CC}+0.3	V	
Bus input voltage	Vbus	18	V	
Allowable power dissipation	Pd	400	mW	Ta ≤ 85°C
Operating temperature	Topr	–40 to +85	°C	
Storage temperature	Tstg	–55 to +125	°C	

Note: Recommended operating power supply voltage range: 5 V ± 0.5 V

Electrical Characteristics

(V_{CC} = 5.0 V, Ta = 25°C)

Item		Symbol	Min	Typ	Max	Unit	Test Conditions	Test Pin	Test Circuit
S1	High-level input voltage	V_{IHS1}	2.1	—	—	V	V1 = 0→5 V, V3 = 0 V, V6 – V5 = 110 mV↑	1	Fig. 1
	Low-level input voltage	V_{ILS1}	—	—	1.65	V	V1 = 5→0 V, V3 = 0 V, V6 – V5 = 30 mV↓	1	
	High-level input current	I_{IHS1}	—	—	1	µA	V1 = 5 V, V3 = 0 V	1	
	Low-level input current	I_{ILS1}	—	—	1	µA	V1 = 0 V, V3 = 0 V	1	
S2	High-level input voltage	V_{IHS2}	2.1	—	—	V	V3 = 0→5 V, V1 = 0 V, V6 – V5 = 110 mV↑	3	Fig. 1
	Low-level input voltage	V_{ILS2}	—	—	1.65	V	V3 = 5→0 V, V1 = 0 V, V6 – V5 = 30 mV↓	3	
	High-level input current	I_{IHS2}	—	—	1	µA	V1 = 0 V, V3 = 5 V	3	
	Low-level input current	I_{ILS2}	—	—	1	µA	V1 = 0 V, V3 = 0 V	3	
Driver	High-level output voltage (+)	V_{OHD+}	1.8	2.5	3.2	V	V1 = 5 V, V3 = 0 V	6	Fig. 1
	High-level output voltage (–)	$V_{OHD–}$	1.8	2.5	3.2	V	V1 = 5 V, V3 = 0 V	5	
	High-level output current	I_{OH}	3.1	3.8	4.5	mA	V1 = 5 V, V3 = 0 V, $I_{OH} = ((V_{OHD+}) – (V_{OHD–}))/60$	5, 6	
	Low-level output current	I_{OL}	—	—	1	µA	V1 = 0 V, V3 = 0 V, $I_{OL} = ((V_{OP+}) – (V_{OP–}))/R_I$	5, 6	
Reference operating voltage (+)		V_{OP+}	2.3	2.5	2.7	V	V1 = 0 V, V3 = 0 V	6	Fig. 1
Reference operating voltage (–)		$V_{OP–}$	2.3	2.5	2.7	V	V1 = 0 V, V3 = 0 V	5	Fig. 1
Driver output resistance *[1]		R_O	5	10	15	kΩ	V1 = 5 V, V3 = 0 V, V8 = 5 V, R_O = 0.6 V/(I6A – I6B)		Fig. 3

Note: 1. Measure the current when V6 = (V_{OP+}) + 0.3 V to make I6A and measure the current when V6 = (V_{OP+}) – 0.3 V to make I6B.

Electrical Characteristics (cont.)

(V_{CC} = 5.0 V, Ta = 25°C)

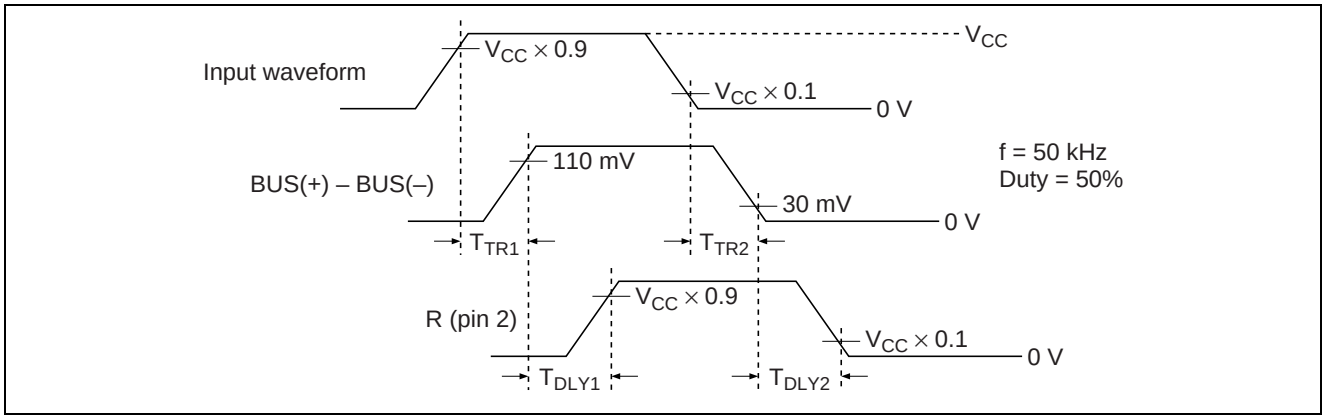
Item		Symbol	Min	Typ	Max	Unit	Test Conditions	Test Pin	Test Circuit
Receiver	High-level input voltage (1)	V_{IH1}	—	80	110	mV	V6 = 0→5 V, Pin2 = 4 V or more, V1 = 0 V, V3 = 0 V, V5 = 0 V, V_{IH1} = V6 – V5	2	Fig. 2
	High-level input voltage (2)	V_{IH2}	—	80	110	mV	V6 = 0→5 V, Pin2 = 4 V or more, V1 = 0 V, V3 = 0 V, V5 = 4.5 V, V_{IH2} = V6 – V5	2	
	Low-level input voltage (1)	V_{IL1}	30	50	—	mV	V6 = 5→0 V, Pin2 = 1 V or less, V1 = 0 V, V3 = 0 V, V5 = 0 V, V_{IL1} = V6 – V5	2	
	Low-level input voltage (2)	V_{IL2}	30	50	—	mV	V6 = 5→0 V, Pin2 = 1 V or less, V1 = 0 V, V3 = 0 V, V5 = 4.5 V, V_{IL2} = V6 – V5	2	
	Input hysteresis voltage (1)	V_{IHYS1}	15	30	45	mV	V_{IHYS1} = V_{IH1} – V_{IL1}		
	Input hysteresis voltage (2)	V_{IHYS2}	15	30	45	mV	V_{IHYS2} = V_{IH2} – V_{IL2}		
	High-level common-mode input voltage	V_{IHCOM}	4.5	—	—	V	V5 = 0→5 V, V5 when pin2 = 4 V or less, V1 = 0 V, V3 = 0 V, V6 – V5 = 110 mV	5	Fig. 2
	Low-level common-mode input voltage	V_{ILCOM}	5	—	—	V	V5 = 0→5 V, V5 when pin2 = 0.3 V or more, V1 = 0 V, V3 = 0 V, V6 – V5 = 30 mV	5	
	Input resistance *[1]	R_I	25	35	45	kΩ	V1 = 0 V, V3 = 0 V, V8 = 5 V, R_I = 0.6 V/(I6A – I6B)	5, 6	Fig. 3
	High-level output leakage current 1	I_{OH1}	—	—	1	μA	V1 = 5 V, V3 = 0 V, V8 = 5 V	2	Fig. 1
	High-level output leakage current 2	I_{OH2}	—	—	1	μA	V_{CC} = 0 V, V1,V3,V8 = 0 V	2	
	High-level output leakage current 3	I_{OH3}	—	—	1	μA	V1,V3,V8 = 0 V	2	
	Low-level output voltage 1	V_{OL1}	—	—	0.6	V	V1 = 0 V, V3 = 0 V, V8 = 5 V, Adjust V_{RL} to make apply current = 1.5 mA	2	
	Low-level output voltage 2	V_{OL2}	—	—	0.3	V	V1 = 0 V, V3 = 0 V, V8 = 5 V, Adjust V_{RL} to make apply current = 200 μA	2	
Quiescent current 1		$I_{CC}H$	4.5	6.5	8.5	mA	V1 = 5 V, V3 = 0 V	7	Fig. 1
Quiescent current 2		$I_{CC}L$	1.05	1.46	1.87	mA	V1 = 0 V, V3 = 0 V	7	Fig. 1
Driver delay time (L→H)		T_{TR1}	—	100	300	ns	See operating waveform figure	5, 6	Fig. 5
Driver delay time (H→L)		T_{TR2}	—	100	300	ns	See operating waveform figure	5, 6	
Receiver delay time (L→H)		T_{DLY1}	—	600	1200	ns	See operating waveform figure	2	
Receiver delay time (H→L)		T_{DLY2}	—	200	600	ns	See operating waveform figure	2	

Note: 1. Measure the current when V6 = (V_{OP+}) + 0.3 V to make I6A and measure the current when V6 = (V_{OP+}) – 0.3 V to make I6B.

Electrical Characteristics (cont.)

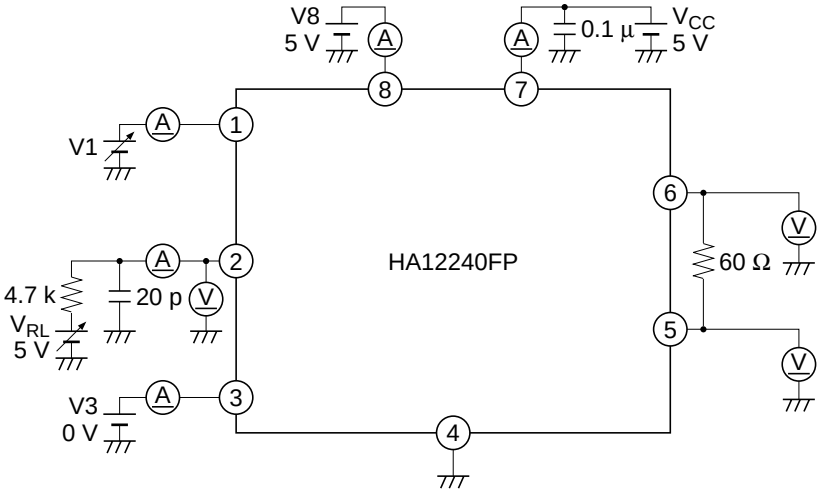
(V_{CC} = 5.0 V, Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions	Test Pin	Test Circuit
Power-supply off output leakage current	I_{OLEAK}	—	—	1	µA	V_{CC} = 0 V, V8 = 0 V, V6 = 5 V, V1 = 0 V, V3 = 0 V, SW1 ON	6	Fig. 4
Standby mode current drain	I_{CCstb}	—	—	1	µA	V1 = 5 V, V3 = 0 V, V8 = 0 V	7	Fig. 4
Standby mode output leakage current	Istb-Leak	—	—	1	µA	V1 = 5 V, V3 = 0 V, V8 = 0 V, V6 = 5 V, SW1 ON	6	Fig. 4
Standby mode high-level input voltage	VstbH	2	—	—	V	V8 = 0→5 V, V8 when pin5,6 = 2.3 V or more, V1 = 0 V, V3 = 0 V	8	Fig. 1
Standby mode low-level input voltage	VstbL	—	—	0.9	V	V8 = 5→0 V, V8 when current flowing into pin7 = 1 µA or less, V1 = 5 V, V3 = 0 V	8	Fig. 1
Standby mode high-level input current	IstbH	—	50	100	µA	V1 = 5 V, V3 = 0 V, V8 = 5 V	8	Fig. 1
Standby mode low-level input current	IstbL	—	—	1	µA	V1 = 5 V, V3 = 0 V, V8 = 0 V	8	Fig. 1

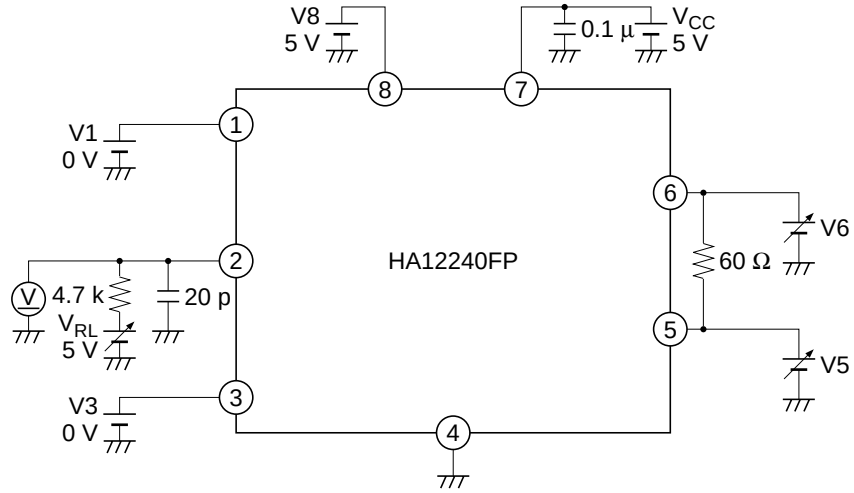


Input/Output Waveform Figure

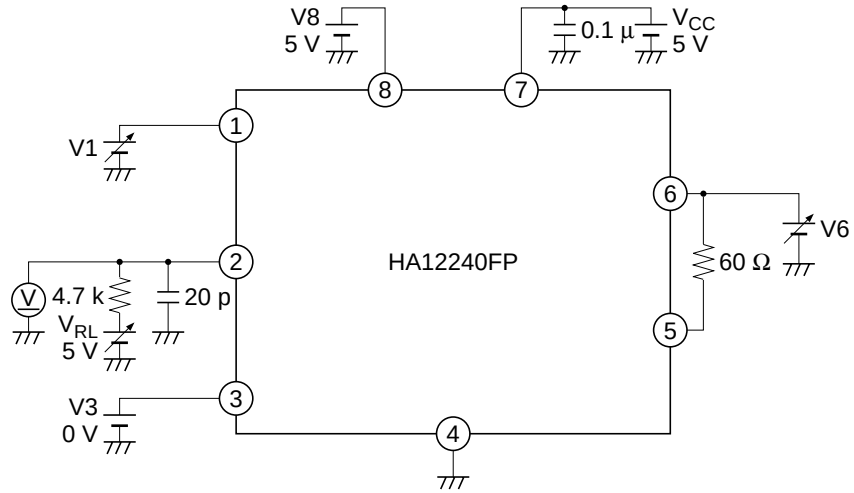
Test Circuits



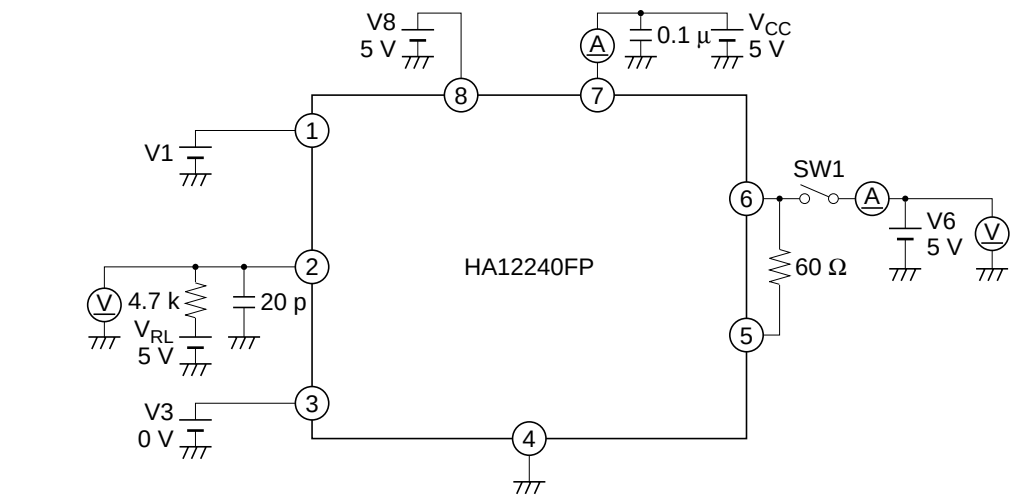
Test Circuit 1



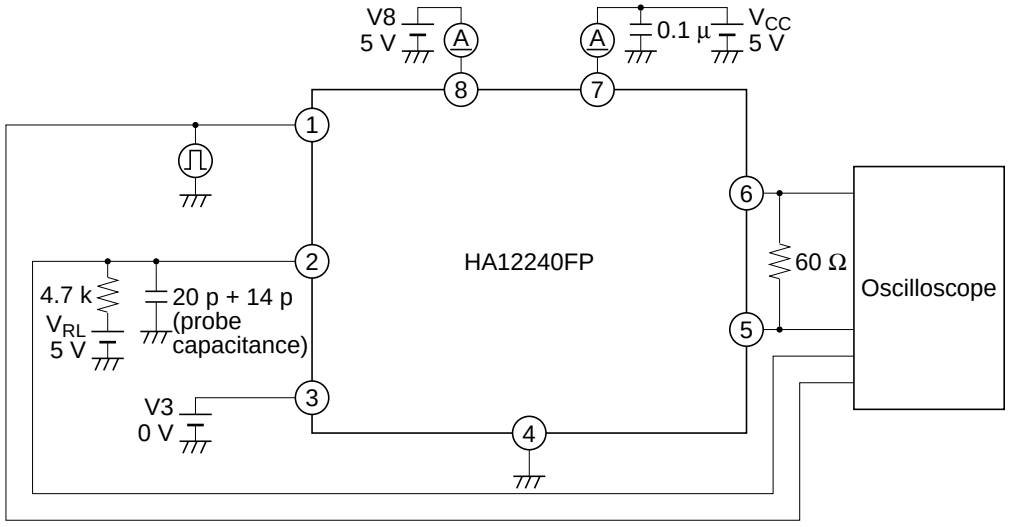
Test Circuit 2



Test Circuit 3

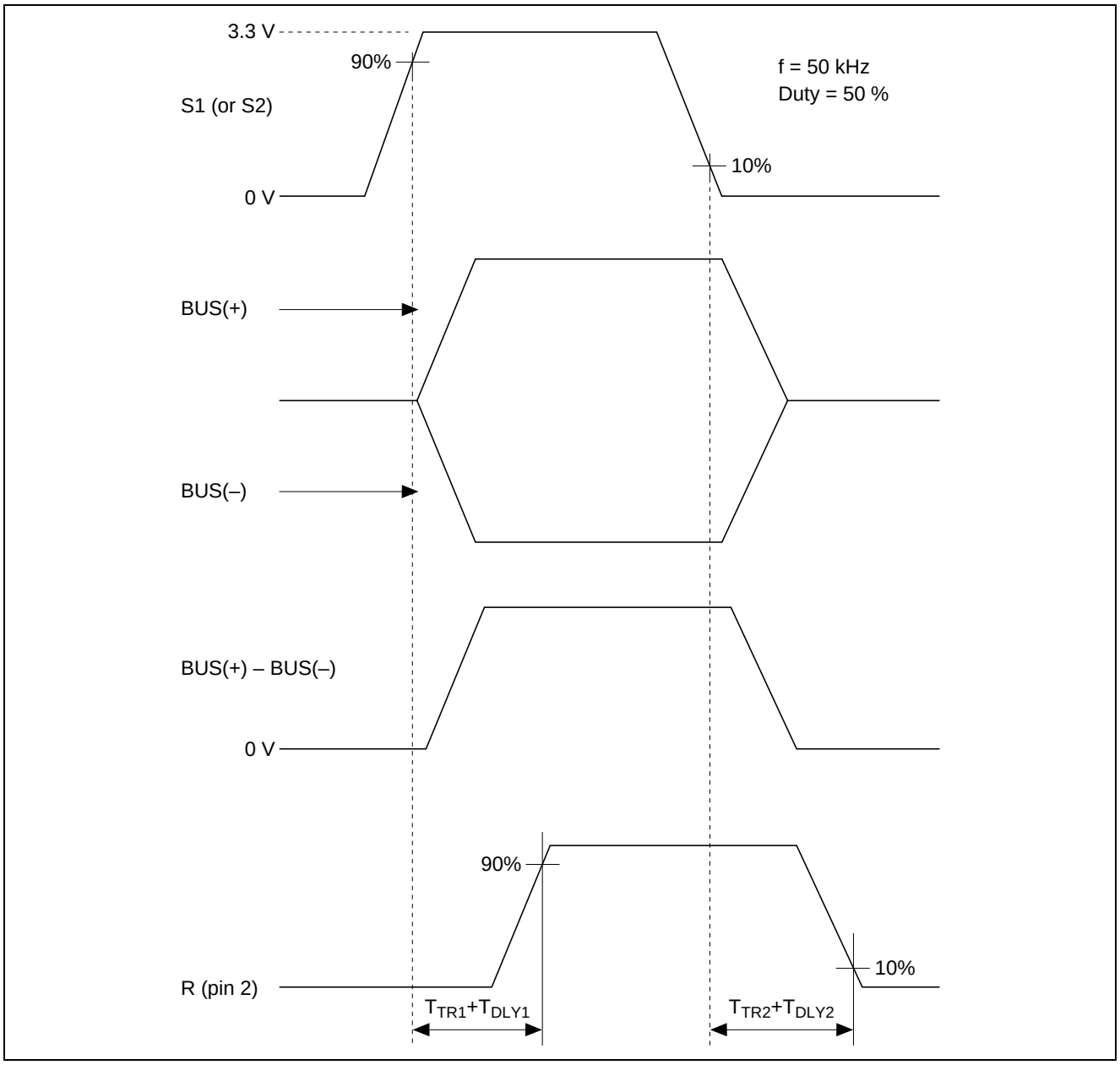


Test Circuit 4

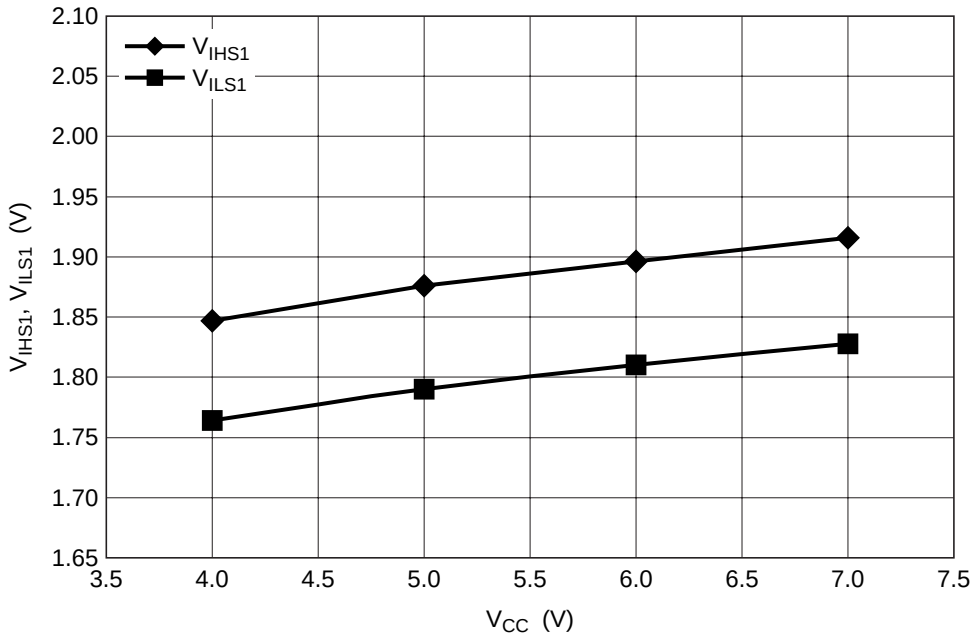


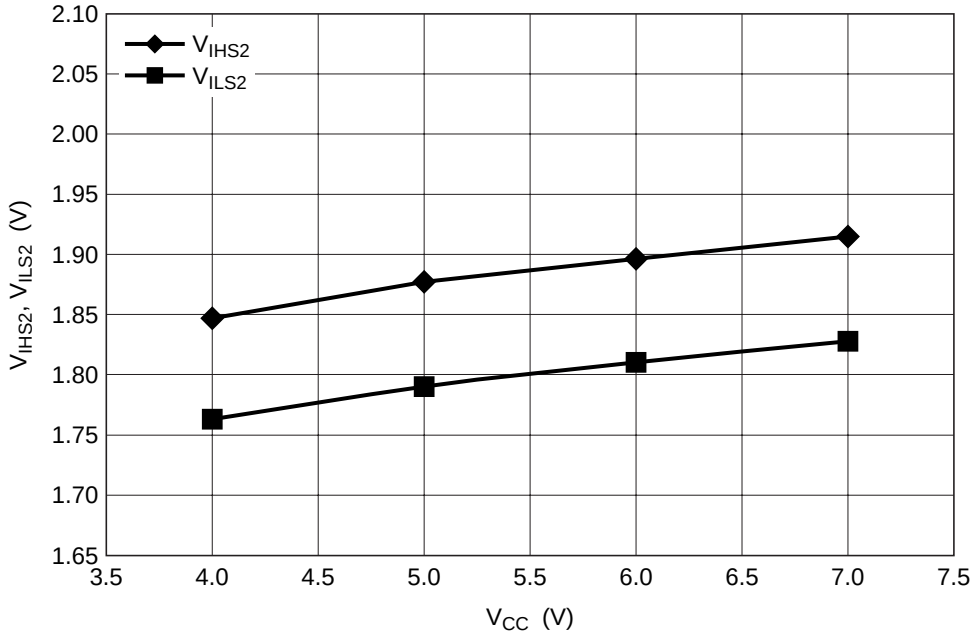
Test Circuit 5

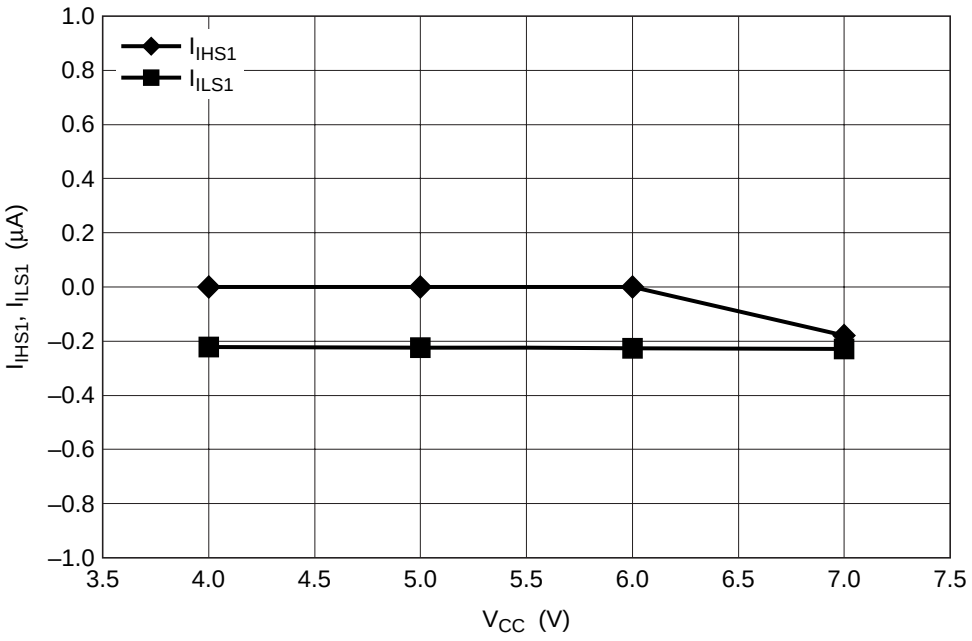
Operating Waveforms



Main Characteristics



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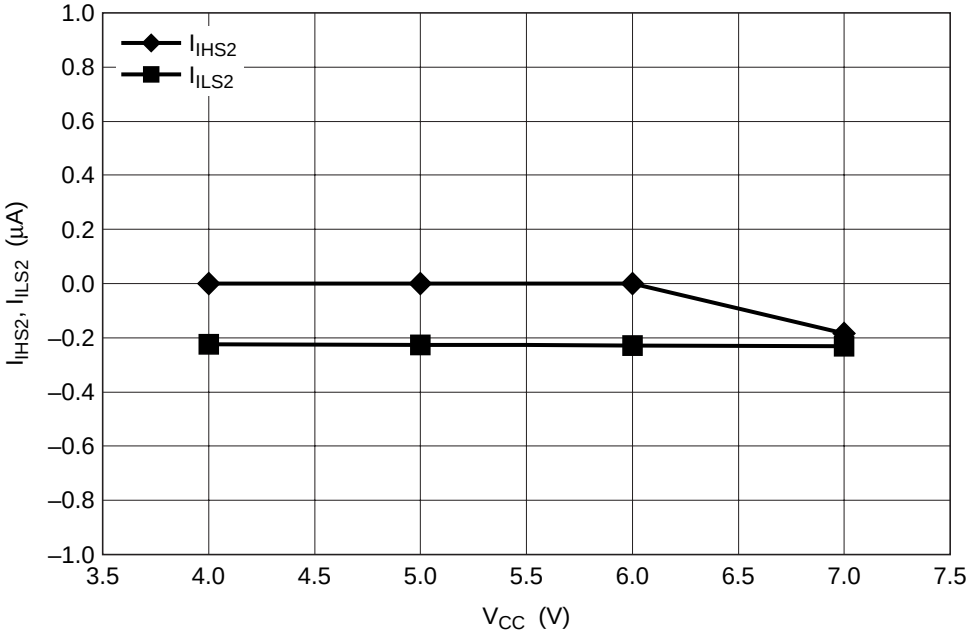
0.8
0.6
0.4
0.2
0.0
–0.2
–0.4
–0.6
–0.8
–1.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
I_{IHS1}
I_{ILS1}
I_{IHS1}, I_{ILS1} (µA)
V_{CC} (V)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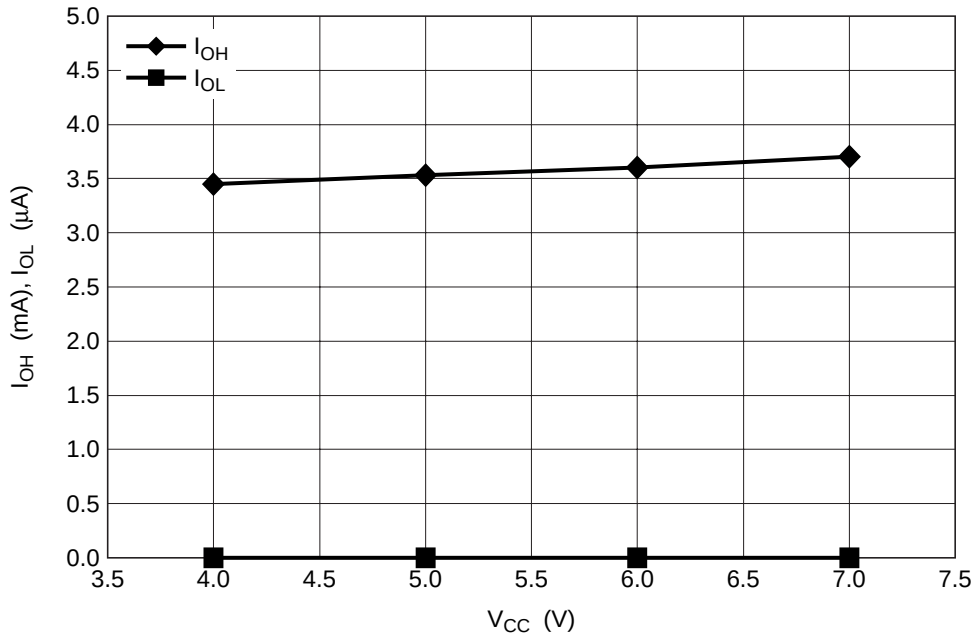
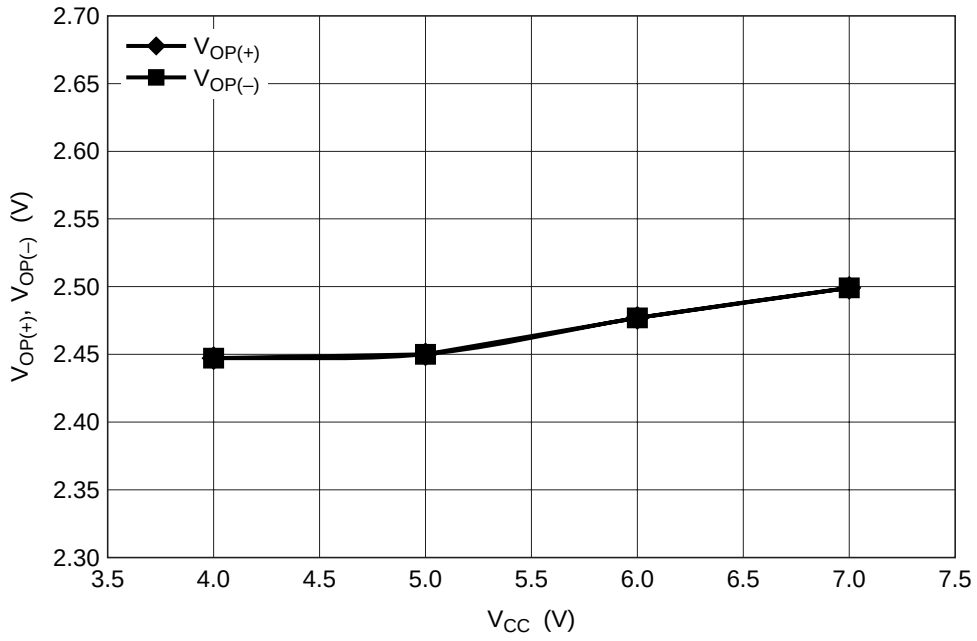
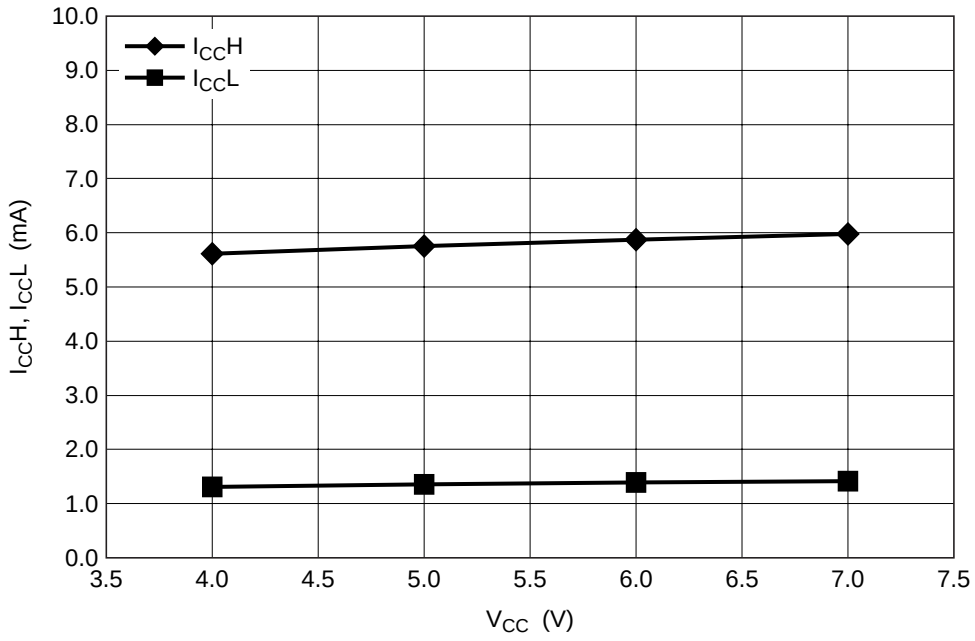
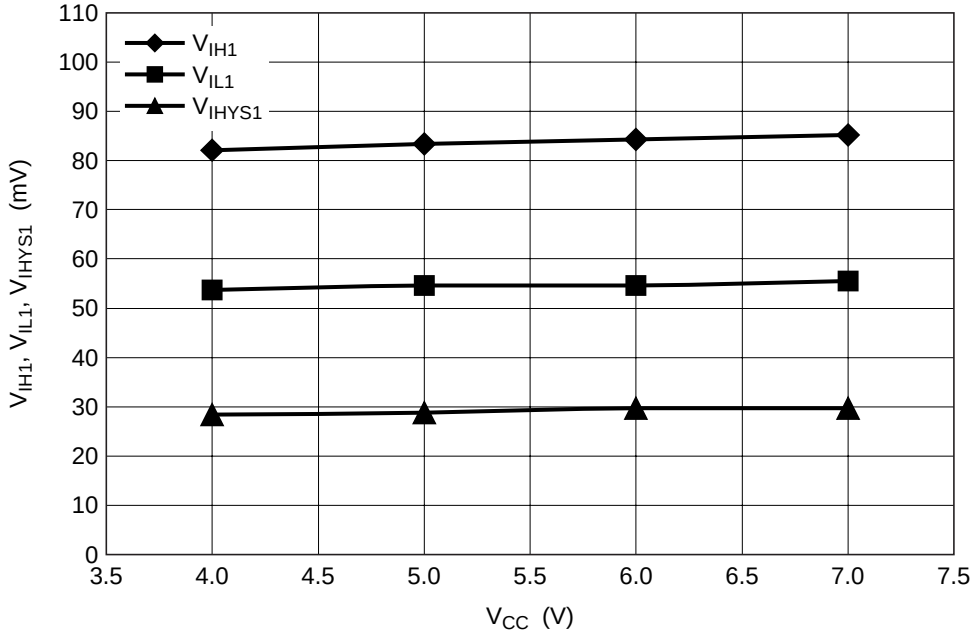
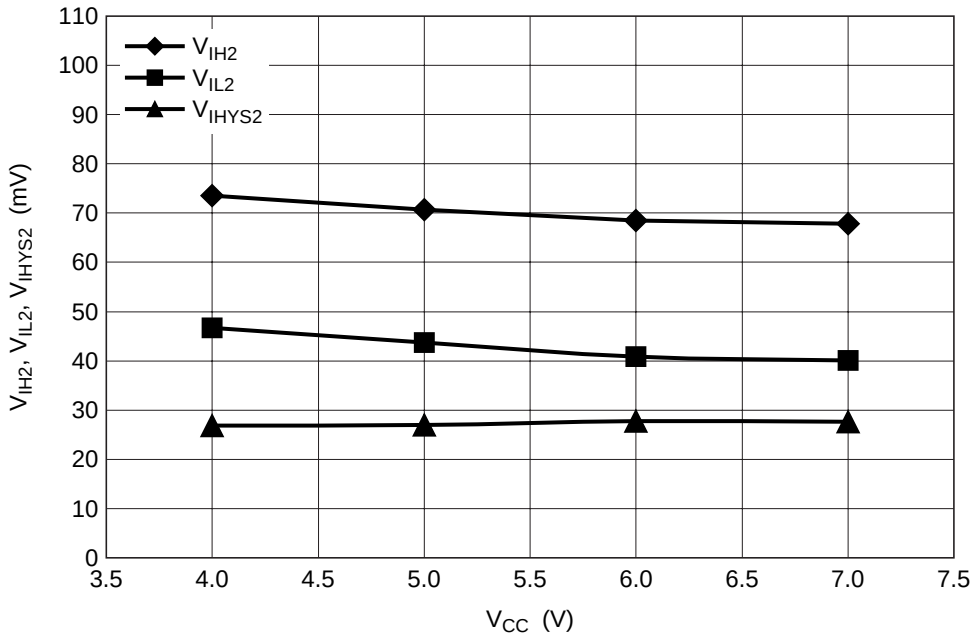
0.6
0.4
0.2
0.0
–0.2
–0.4
–0.6
–0.8
–1.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
I_{IHS2}
I_{ILS2}
I_{IHS2}, I_{ILS2} (µA)
V_{CC} (V)

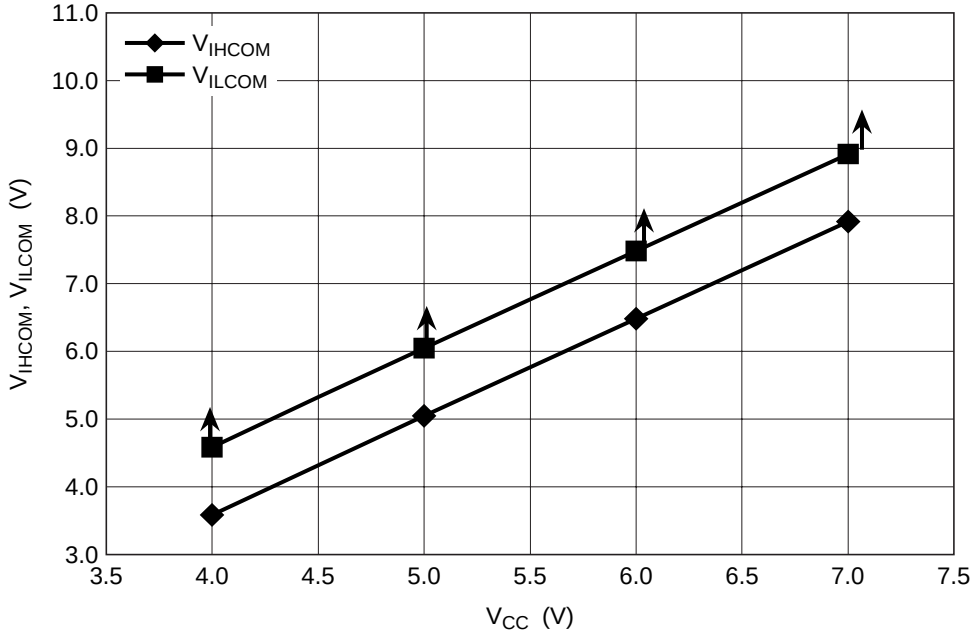

5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
IOH
IOL
IOH (mA), IOL (µA)
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
VCC (V)

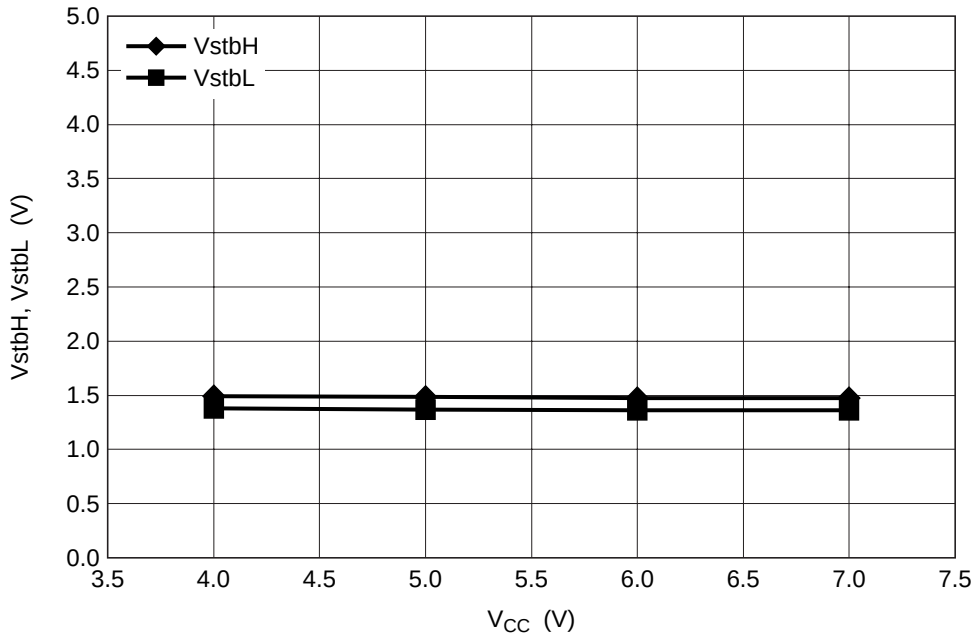

2.70
2.65
2.60
2.55
2.50
2.45
2.40
2.35
2.30
VOP(+)
VOP(–)
VOP(+), VOP(–) (V)
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
VCC (V)

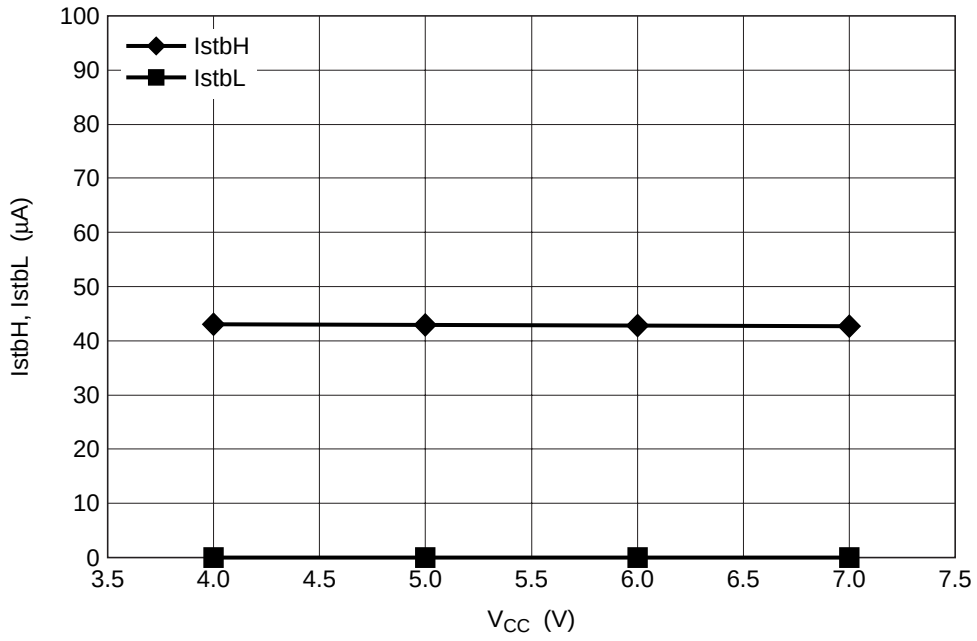

10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ICCH
ICCL
ICCH, ICCL (mA)
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
VCC (V)


110
100
90
80
70
60
50
40
30
20
10
0
VIH1
VIL1
VIHYS1
VIH1, VIL1, VIHYS1 (mV)
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
VCC (V)


110
100
90
80
70
60
50
40
30
20
10
0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
VIH2
VIL2
VIHYS2
VIH2, VIL2, VIHYS2 (mV)
VCC (V)


11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
VIHCOM
VILCOM
VIHCOM, VILCOM (V)
VCC (V)


VstbH
VstbL
VstbH, VstbL (V)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
VCC (V)


IstbH
IstbL
IstbH, IstbL (µA)
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90
80
70
60
50
40
30
20
10
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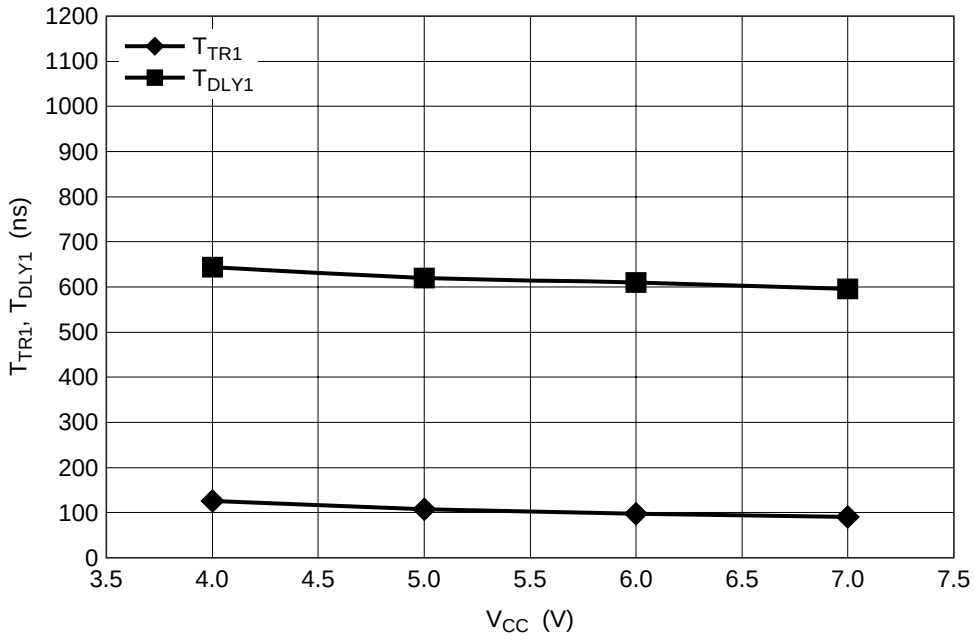
6.0
6.5
7.0
7.5
VCC (V)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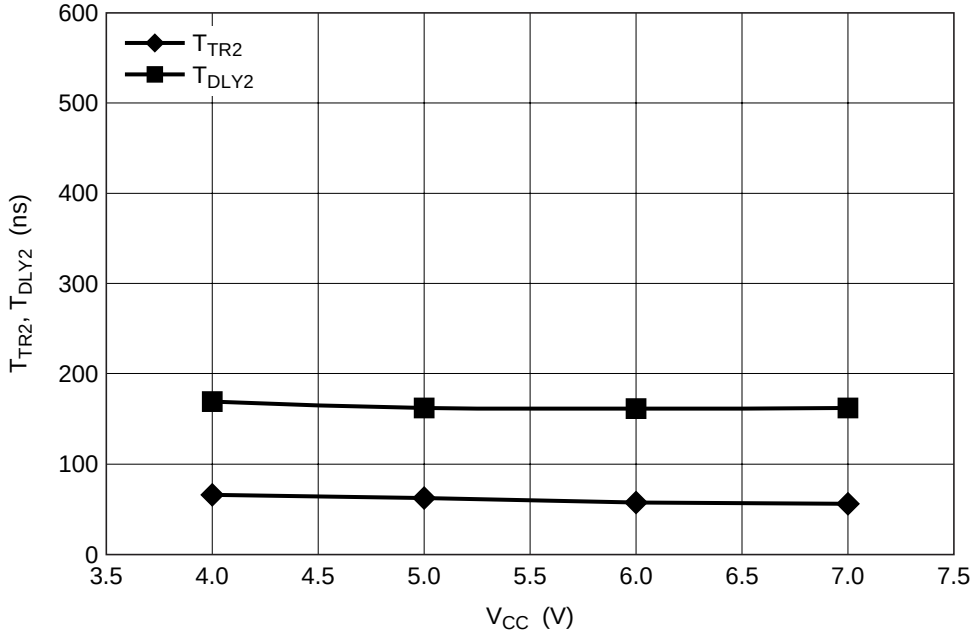
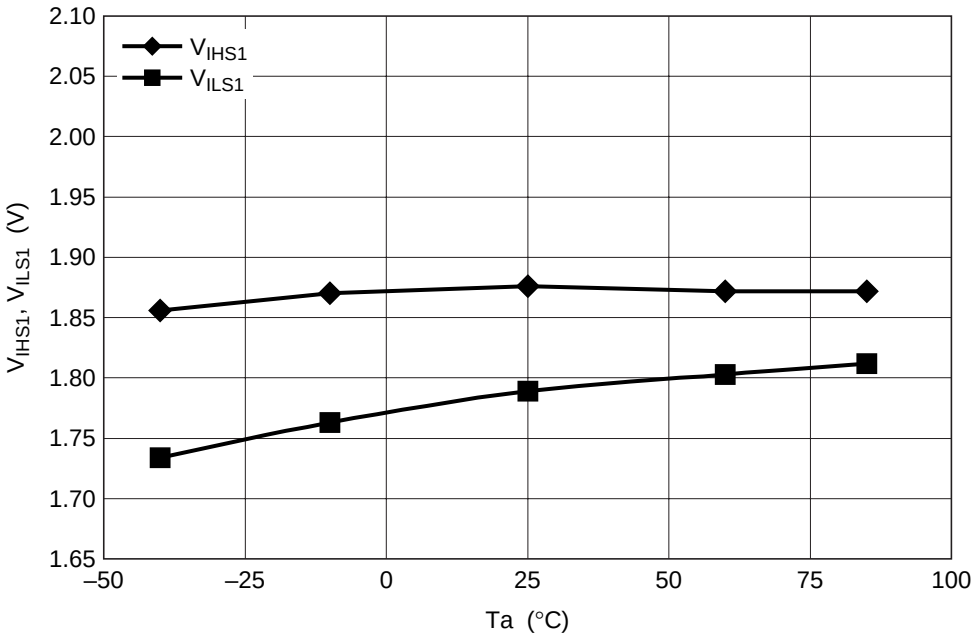
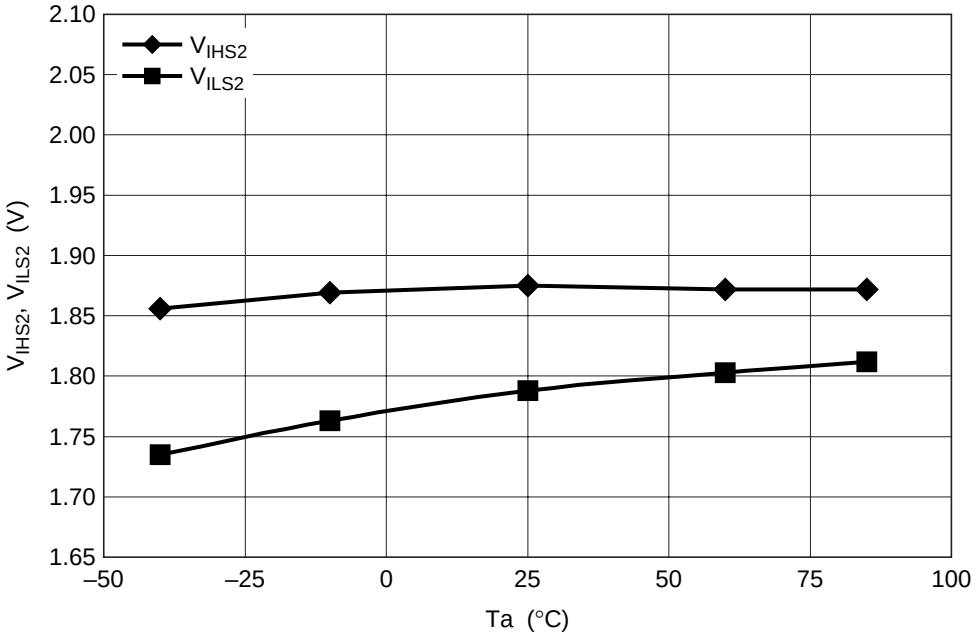
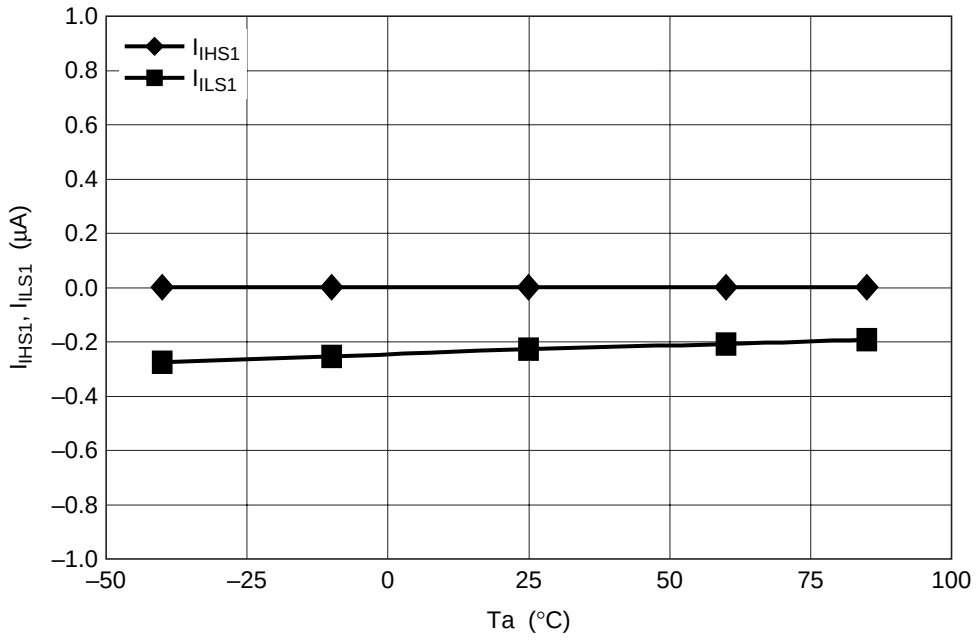
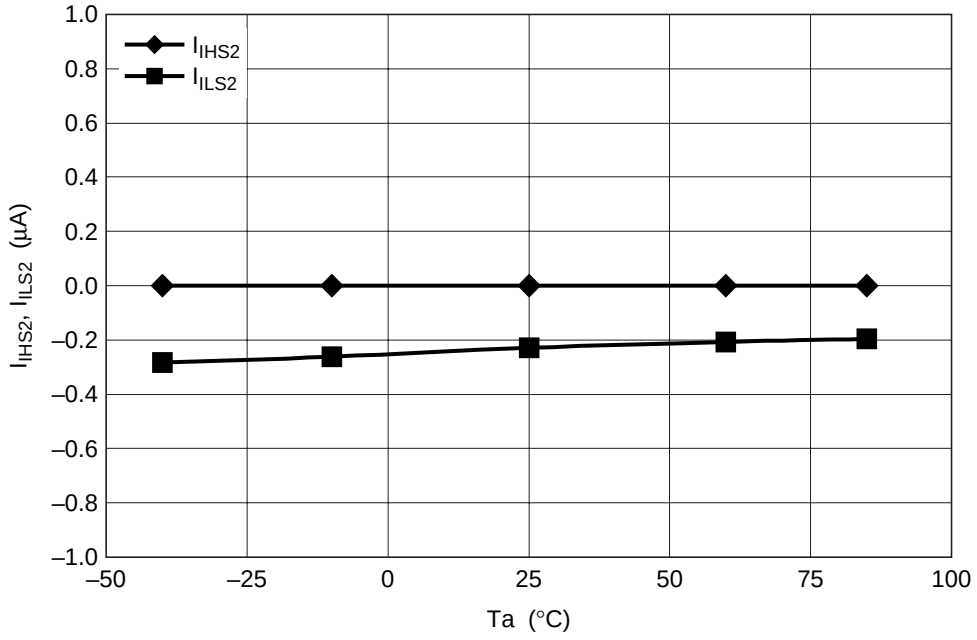
1100
1000
900
800
700
600
500
400
300
200
100
0
T_{TR1}
T_{DLY1}
T_{TR1}, T_{DLY1} (ns)
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
V_{CC} (V)

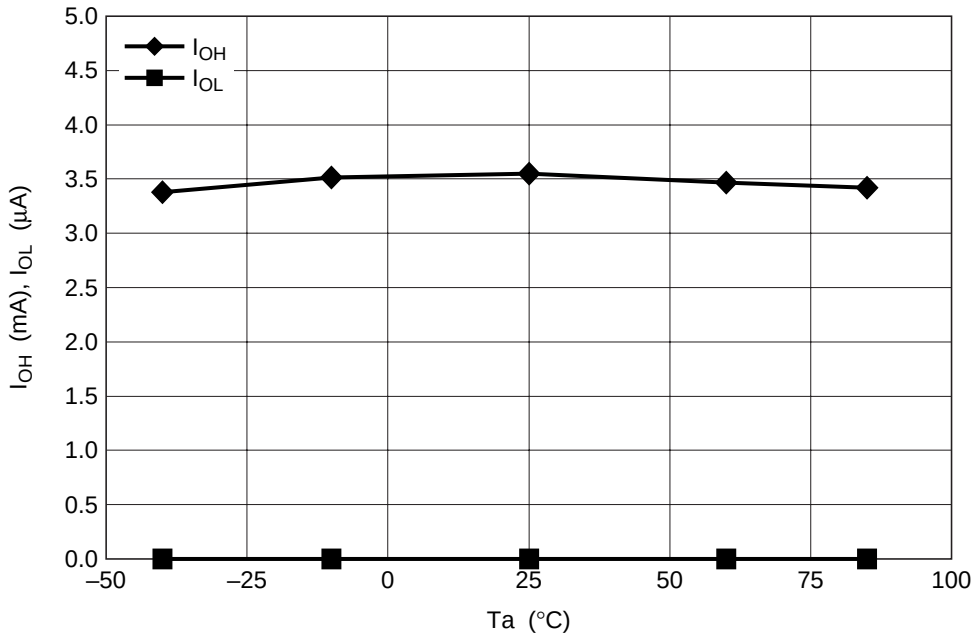

600
500
400
300
200
100
0
T_{TR2}
T_{DLY2}
T_{TR2}, T_{DLY2} (ns)
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
V_{CC} (V)

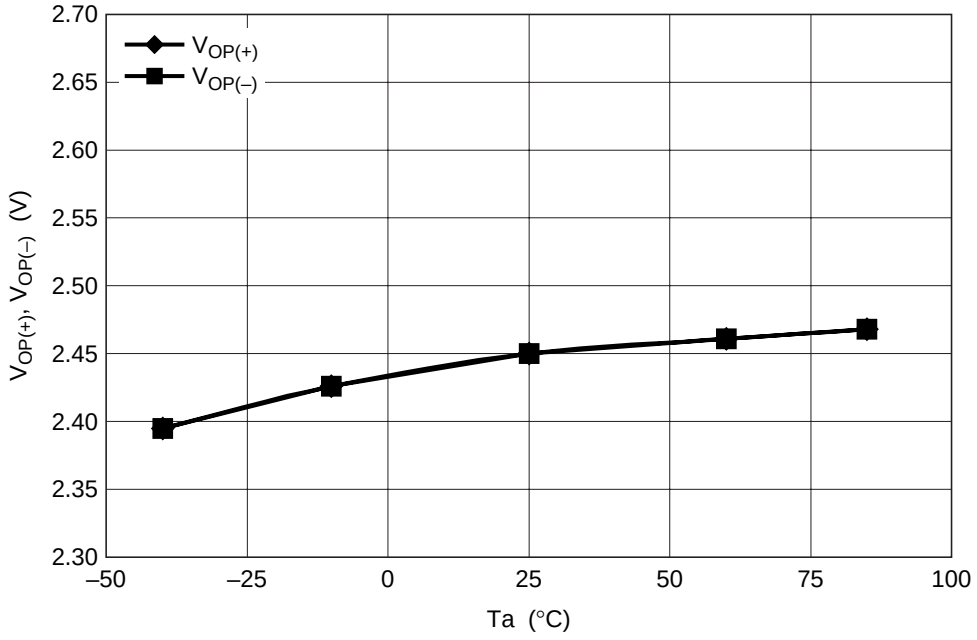

2.10
2.05
2.00
1.95
1.90
1.85
1.80
1.75
1.70
1.65
VIHS1
VILS1
VIHS1, VILS1 (V)
–50
–25
0
25
50
75
100
Ta (°C)

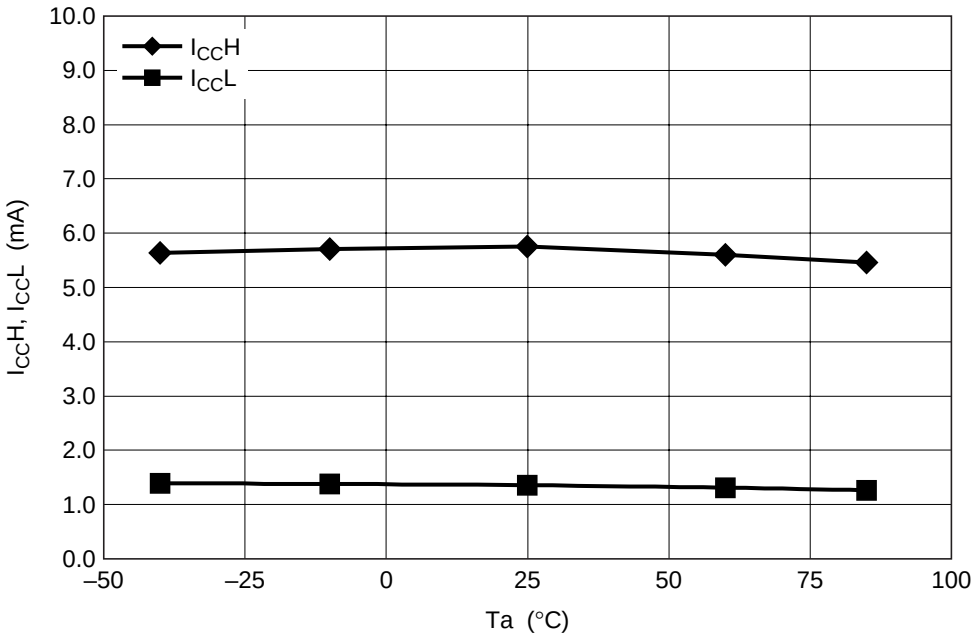

2.10
2.05
2.00
1.95
1.90
1.85
1.80
1.75
1.70
1.65
VIHS2
VILS2
VIHS2, VILS2 (V)
–50
–25
0
25
50
75
100
Ta (°C)

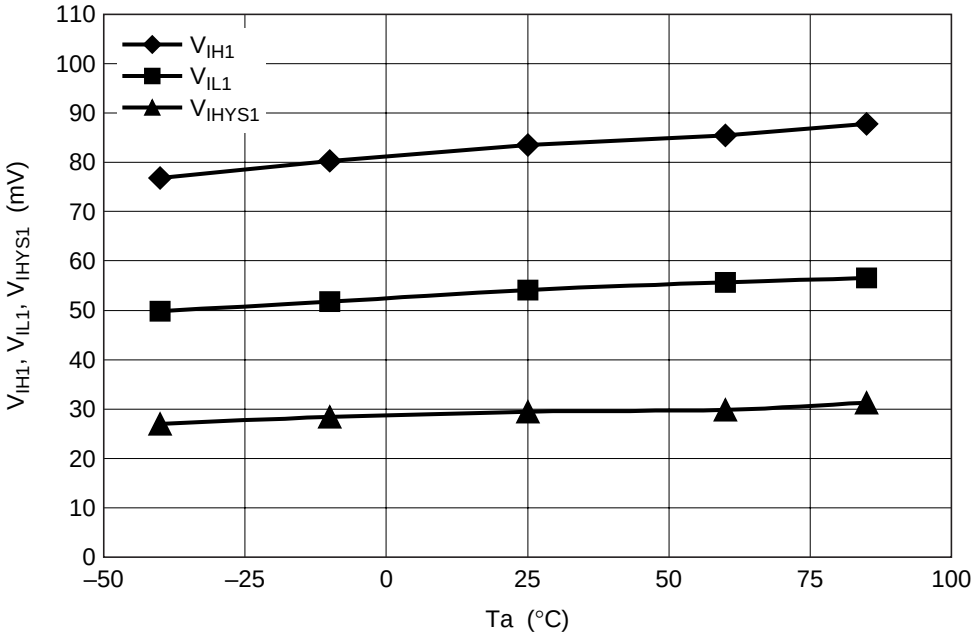

1.0
0.8
0.6
0.4
0.2
0.0
–0.2
–0.4
–0.6
–0.8
–1.0
–50
–25
0
25
50
75
100
Ta (°C)
IIHS1, IILS1 (µA)
IIHS1
IILS1

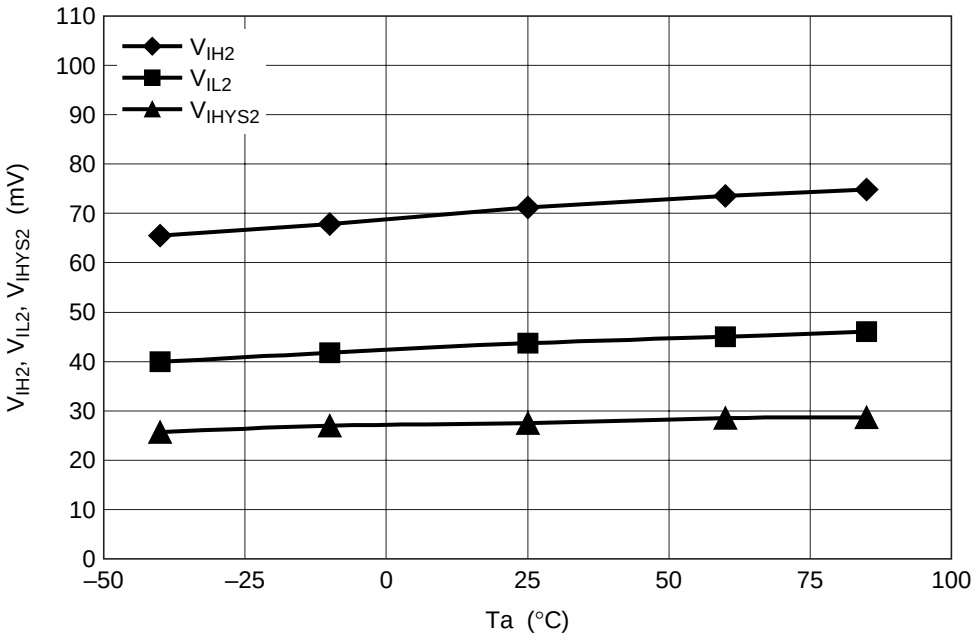

1.0
0.8
0.6
0.4
0.2
0.0
–0.2
–0.4
–0.6
–0.8
–1.0
–50
–25
0
25
50
75
100
Ta (°C)
IIHS2, IILS2 (µA)
IIHS2
IILS2

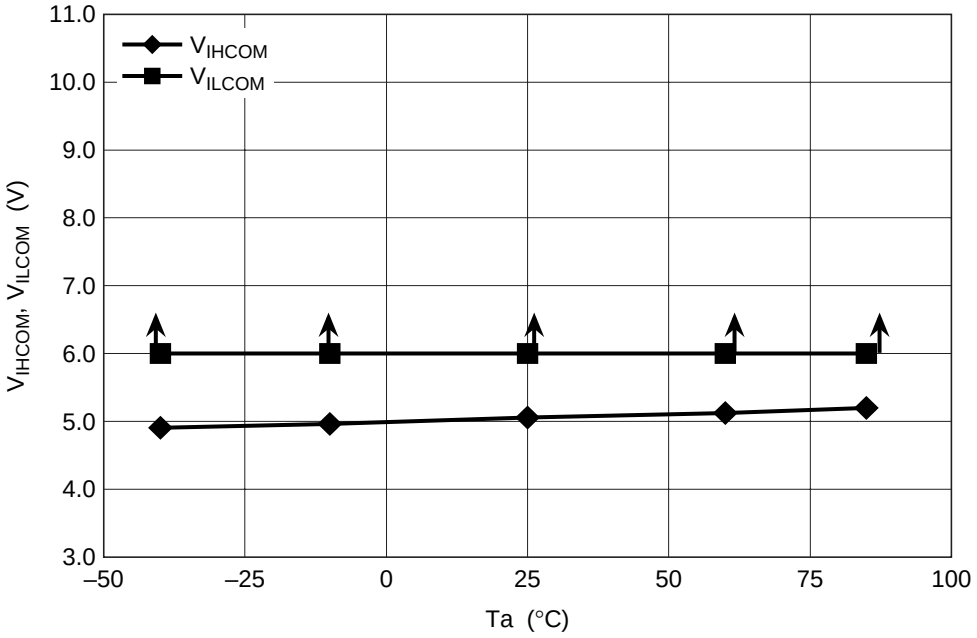

5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
IOH
IOL
IOH (mA), IOL (µA)
–50
–25
0
25
50
75
100
Ta (°C)

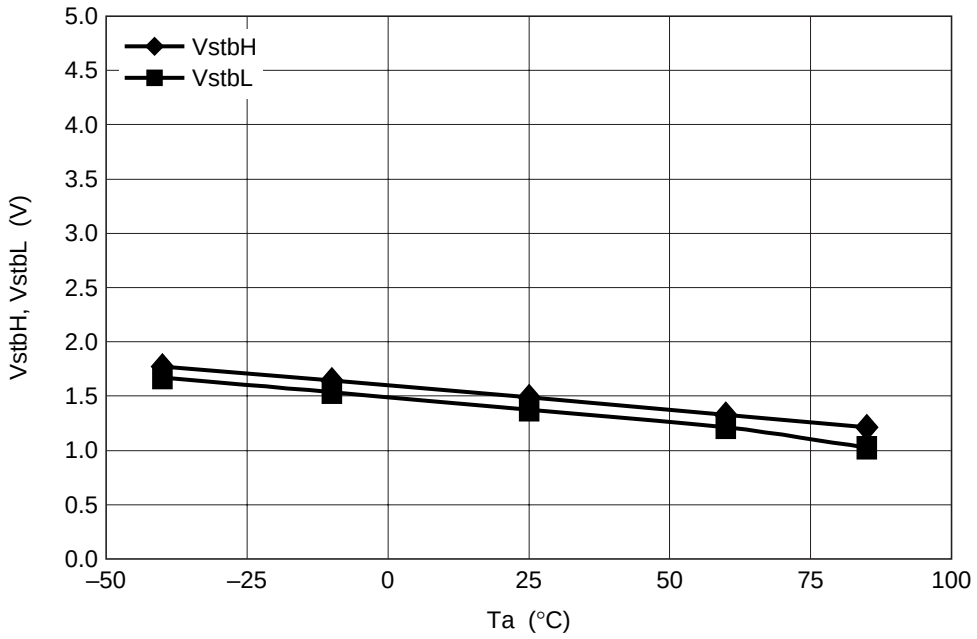

2.70
2.65
2.60
2.55
2.50
2.45
2.40
2.35
2.30
VOP(+)
VOP(–)
VOP(+), VOP(–) (V)
–50
–25
0
25
50
75
100
Ta (°C)

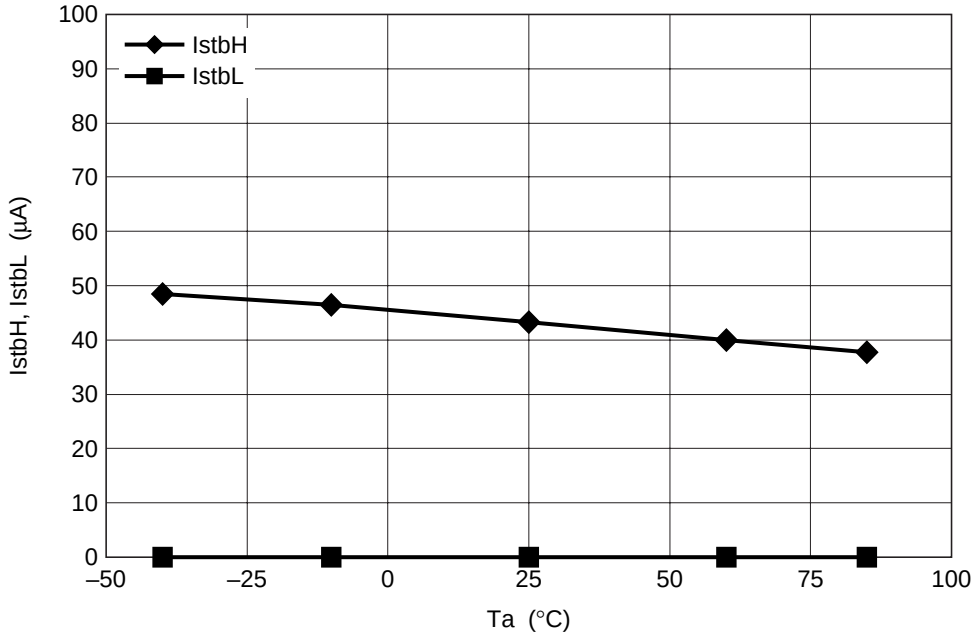

10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ICCH
ICCL
ICCH, ICCL (mA)
–50
–25
0
25
50
75
100
Ta (°C)

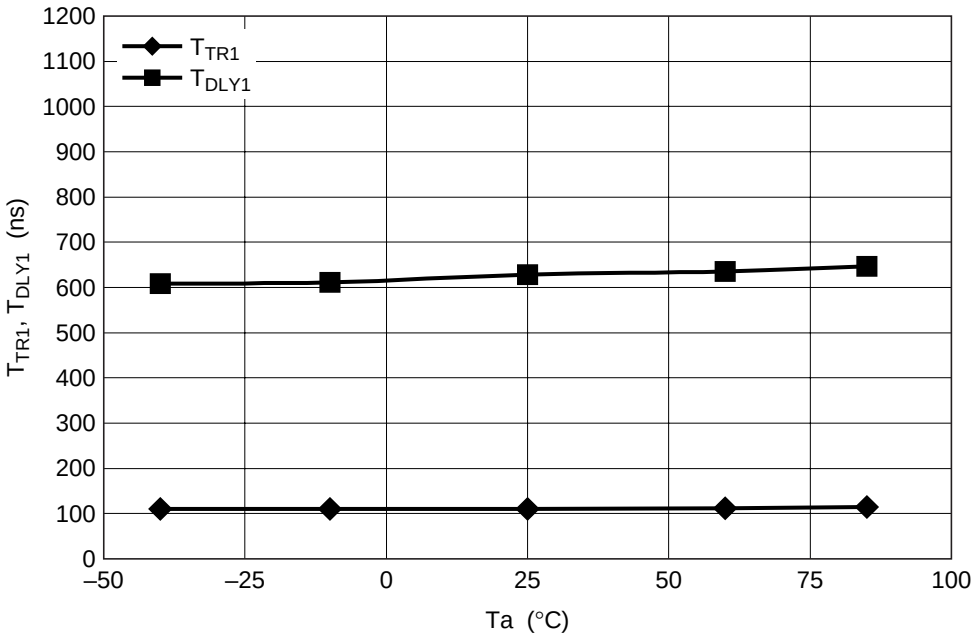

110
100
90
80
70
60
50
40
30
20
10
0
VIH1
VIL1
VIHYS1
VIH1, VIL1, VIHYS1 (mV)
–50
–25
0
25
50
75
100
Ta (°C)

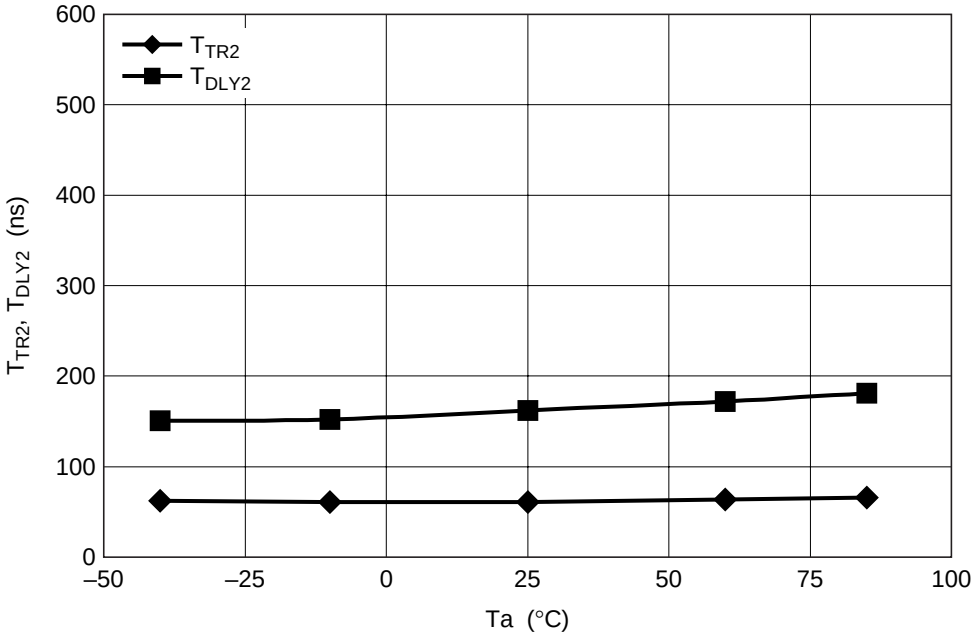

110
100
90
80
70
60
50
40
30
20
10
0
–50
–25
0
25
50
75
100
VIH2
VIL2
VIHYS2
VIH2, VIL2, VIHYS2 (mV)
Ta (°C)


11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
–50
–25
0
25
50
75
100
VIHCOM
VILCOM
VIHCOM, VILCOM (V)
Ta (°C)


VstbH
VstbL
VstbH, VstbL (V)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
–50
–25
0
25
50
75
100
Ta (°C)

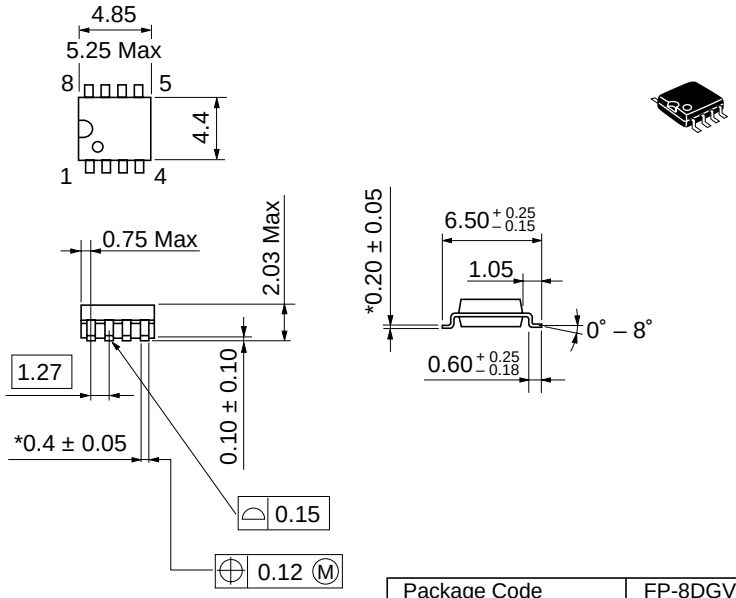

IstbH
IstbL
IstbH, IstbL (µA)
100
90
80
70
60
50
40
30
20
10
0
–50
–25
0
25
50
75
100
Ta (°C)


1200
1100
1000
900
800
700
600
500
400
300
200
100
0
T_{TR1}
T_{DLY1}
T_{TR1}, T_{DLY1} (ns)
–50
–25
0
25
50
75
100
Ta (°C)


600
500
400
300
200
100
0
T_{TR2}
T_{DLY2}
T_{TR2}, T_{DLY2} (ns)
–50
–25
0
25
50
75
100
Ta (°C)

Package Dimensions

Unit: mm



*Dimension including the plating thickness

Package Code	FP-8DGV
JEDEC	—
JEITA	Conforms
Mass (reference value)	0.10 g

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